FACTORS AFFECTING THE AUCTION PRICES OF BORDEAUX RED WINE

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ABSTRACT

Auctions of red wine have attracted increasing attentions over the years. The bidders are no longer restricted to wine merchants who solely aim at refilling their inventory. Recently, many private individuals start regarding red wine as a form of investment and actively participating in the auctions held by houses like Sotheby's and Christie's. As there is no fixed rule for pricing red wine, there is a need for model that helps bidders to evaluate their own bid prices in an objective and systematic manner.

The objective of this study is to test factors that are widely believed to have effects on the hammer prices of red wine. The factors tested are vintage, scores assigned by wine critic, form of offer (single bottle or a dozen in case), ullage, and label condition. Price data of red wine from five major producers in the French Bordeaux region, i.e. Chateau Lafite, Chateau Latour, Chateau Margaux, Chateau Mouton-Rothschild and Chateau Haut-Brion, are collected due to their high turnover in major auctions and their reputation as investment grade wine. Multiple regressions were conducted to test two assumptions stated later. The regressions cover data of individual producer and also the data of all the producers combined.

Results show that vintage and scores assigned by wine critic are the two most dominant factors affecting the prices of red wine in general. Form of offer, ullage and label condition, though perceived as important criteria by bidders, cannot explain hammer prices in some cases. In fact, different brands respond in different degrees to the five factors tested and necessary adjustments have to be made.

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CHAPTER 1

INTRODUCTION

Red Wine from the French Bordeaux

For many people, "Bordeaux" is synonymous with Red Wine. Despite the fact that red wine are produced in many places around the world, e.g. Adelaide Hills in Australia, Barolo in Italy and Napa Valley in the United States etc., red wine produced from Bordeaux in France are without dispute considered to be the best by wine merchants, connoisseurs and collectors. Besides the long tradition of wine making that dated back to the 5th Century B.C, there are three major factors contribute to its fame:

- Longevity
- Quality
- Publicity

Longevity. It is well known that red wine improves with age if it is properly stored. Red wine is considered to be good if it can be stored for 20-30 years or more. However, not every red wine is suitable for aging. It is estimated that only 0.1% of world production can age for 20 years or above. Coincidentally, many of the Bordeaux wine belong to this handful few. Stories have been told that a 1787 bottle of Chateau Margaux that Thomas Jefferson bought from France still tasted good when it was opened in the United States in the late 80s (Sokolin 1998).

Quality. It is demonstrated by the consistency of the wine. Bordeaux wine show less discrepancy in taste than wine from other regions throughout good years (vintage) and bad years (vintage). In addition, the production process of fine wine in France is strictly controlled by law to protect their quality. It is thus considered to be a good buy for expert and lay person alike.

Publicity. Although Bordeaux wine had been circulating in the market for many years, it was not until 1982 did they gained public attention. The wine of 1982 was of exceptional quality which was nearly unprecedented and it was widely publicized by a wine critic, Robert Parker, through his journal, the *Wine Advocate*. Parker made extensive tastings to wide range of red wine ever since and assigned scores to each of them. Many wine consumers follow Parker's advice and his opinion carries a lot weight in the wine trade. His book -"Bordeaux, A comprehensive guide to the wines produced from 1961 to 1997" is considered to be an important reference in the trade.

Top five Bordeaux wine

Among the Bordeaux wine, there is a consensus among connoisseurs on which are the top five. They are: Chateau Lafite, Chateau Latour, Chateau Haut-Brion, Chateau Margaux and Chateau Mouton-Rothschild. They all belong to the "Premier crus", or the "First growth" according to the classification which dated back to 1855.

For the 1855 Exposition Universelle de Paris, the World's Fair of the day, Napoléon III requested a classification system for Bordeaux wines which were to be on display. It was established by brokers in the wine industry who ranked the wines according to a chateau's reputation and trading price, which at that time was directly related to quality. The result was the Bordeaux Wine Official Classification of 1855.

Red wines that made the list all came from the Médoc region with the exception of the Chateau Haut-Brion from Graves which was famous enough to be included. The wines were ranked descending from first to fifth growths called "crus". Within each category, chateaux are ranked in order of quality. In the more than 100 years since the 1855 classification, there has been only one change, when Chateau Mouton-Rothschild was elevated from a second growth to a first growth vineyard in 1973. Today, many people critique the 1855 classification for numerous reasons - some because the great châteaux of Pomerol and Saint-Emilion, among others, are not included; others because chateaux ownership and vineyard holdings are always changing.

Besides belonging to the First Growth in the classification system, the top five are also famous for the great monetary reward they generated for their collectors. For example, a case of 1982 Latour only cost US$ 400 when it was brought in 1982. Its price appreciated to around US$ 7000 in 1998. It implied a compound average growth rate of 19.6% per annum. In fact, the markets for these five wine are liquid enough that make them suitable for either short-term speculation or long term investment.

CHAPTER 2

ABOUT WINE AUCTION

Wine auction

Wine auction is a big business. For the auction season in 1996/97, total turnover was about US$ 70 million and there were over 1 million bottles sold. There are many auctions held every year in Europe and the United States. However, the center of action is still in London where houses like Christie's and Sotheby's dominate the scene.

Christie's has conducted a survey in 1992 to get the profile of its suppliers and customers from both the United Kingdom and elsewhere. At its main branch on King Street, London, Christie's found that private buyers made up 76% of its trade by numbers, although they accounted for only 55% of purchases by value. Buyers from the wine trade, who made up 24% of the total clientele, represented 45% of the lots by value (Sokolin 1998).

Around 80 to 90 percent of the wine for auctions are red wine and most of the rest are port wine and champagne. The reasons for the dominance of red wine, especially Bordeaux red wine, are the ones that are explained earlier.

Factors affecting the hammer price in wine auction

There are several factors that will make wine more or less valuable at an auction. They are listed as follows:

- Vintage
- Celebrity effect
- Provenance
- Ullage
- Label condition
- Scores assigned by critics

Vintage. It means whether the grapes that were harvested in a certain year were good or bad. Bad vintage might be a result of unsuitable weather or plague which are beyond human control. As grapes are the inputs of wine-making, bad inputs lead to bad outputs, no matter how well the process is controlled. Vintage is publicly available information that are "spread on the streets" even before the wine is bottled.

Celebrity effect. It is observed that when a name of a well known collector or a celebrity is attached to a wine consignment, the auction price will increase significantly. One example was the auction of wine collected by Andrew Lloyd Webber, the famous composer of Broadway musicals. It is estimated to have sold for 300 percent more than it ordinarily would have without Webber's name attached to it.

Provenance. Provenance comes from the French word "provenir" which literally mean origin. It is the wine storage history and ownership. Better the provenance, the more assurance there is of its quality and authenticity. Ideally, the wine should be bought upon immediate release from the vineyard and then stored in

perfect conditions until it is put up for auctions. If it does not have consistent ownership or there are some vague storage condition, price will be lowered. Usually, wine auctioned in single bottle cannot be sold at a price as high as those in bulk, i.e. a dozen in case.

Ullage. The term means how well the bottle is filled. Ullage is always described in the catalogue issued for wine auction. It is because wine inside the bottle will evaporate by varying degrees over the years and the degree of evaporation is revelatory to the condition of the wine. Wine evaporated is normal for old wine. However, if the wine is relatively new but it has evaporated to the shoulder level, it probably means that there was air leakage through the cork, not only allowing oxygen but also microbes which can adversely affect the taste. Conversely, if the wine has a normal evaporation it would indicate that its taste has survived the test of time.

Label Condition. If the labels are damaged, this may lower the value of the wine. It is because it is viewed as an indication that the wine was stored in substandard conditions.

Scores assigned by critics. Besides the Parker's score which mentioned earlier, other wine magazines like the *Wine Spectator* also publishes their own score. Some auction houses will open a few bottles of a lot prior to sale for tasting. However, many of them do not have this practice and thus scores by critics becomes the only yardsticks available.

CHAPTER 3

METHODOLOGY

Objective and hypothesis

The objective of the study is to test factors affecting the auction price of red wine. Multiple regressions are used to conduct the test. We postulate that the five factors affect the auction price in an independent manner and that the effect of the two quantitative factors, i.e. vintage and Parker's score on the auction price is linear.

Hence, a model named as Model 1 is constructed as follows:

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5$, where

Y= Auction price

X_1= Vintage (X_1 = 1, 2, …, 10)

X_2= Parker's score (X_2 = 50, 51, …, 100)

X_3= Form of offer (In single bottle = 0, In case = 1)

X_4= Ullage (Good =0, Bad =1)

X_5= Label condition (Good=0, Damaged=1)

X_1 to X_5 include almost all the factors that are explained previously in the last section. As celebrity effect is hard to quantified, it is thus not included. While provenance, i.e. storage condition and history involve details which are difficult to process, it can be replaced by ullage, that is the observable result of provenance.

Regressions are first conducted on each individual wine before the one on the combined data is conducted. The purpose is to see whether the group of the top five Bordeaux wine behave in the same manner to the five factors as mentioned above. Most of all, by testing the significance of the independent variables, we can make suitable adjustments to the model.

However, before we conduct the regression, we have to consider whether the regressions run should be on linear or non-linear basis. Hence, we try to plot two quantitative factors which we consider are the most important, vintage and Parker's score, against the auction prices. Here are our findings:

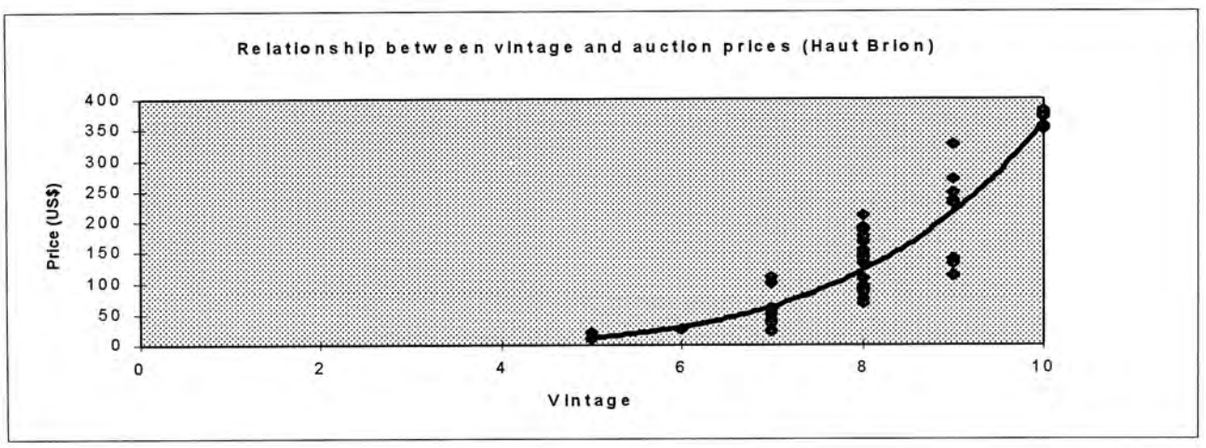

Figure 1A. Relationship between vintage and auction prices (Haut Brion)

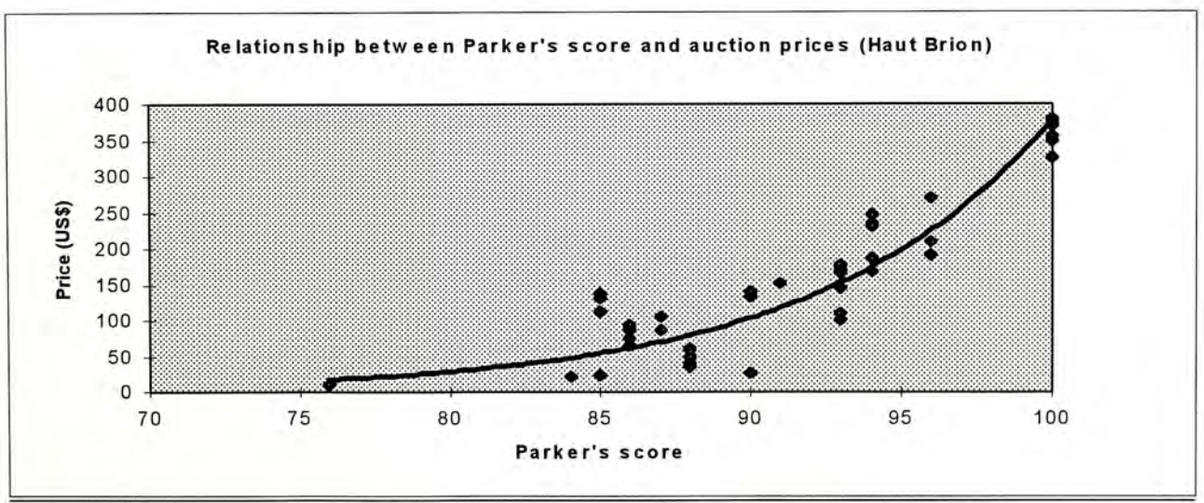

Figure 1B. Relationship between Parker's score and auction prices (Haut Brion)

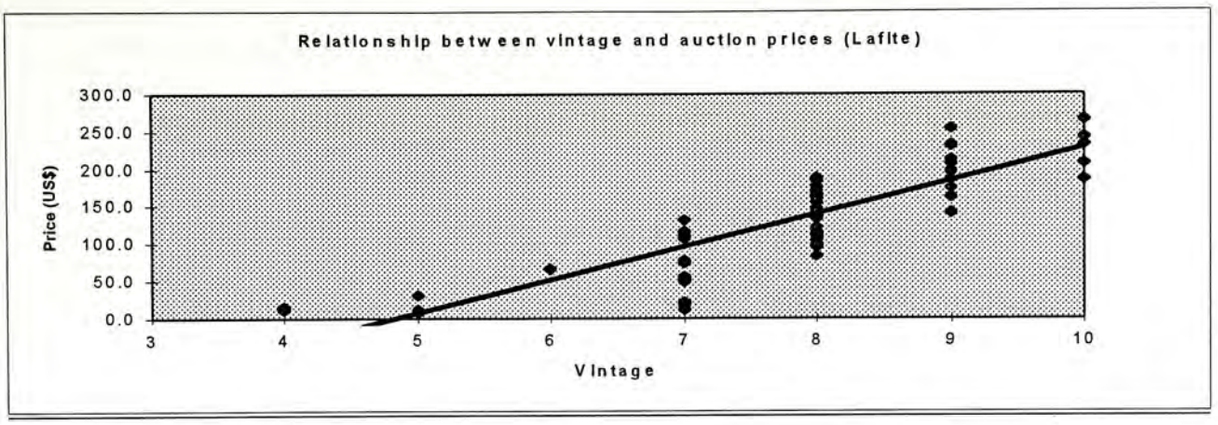

Figure 2A. Relationship between vintage and auction prices (Lafite)

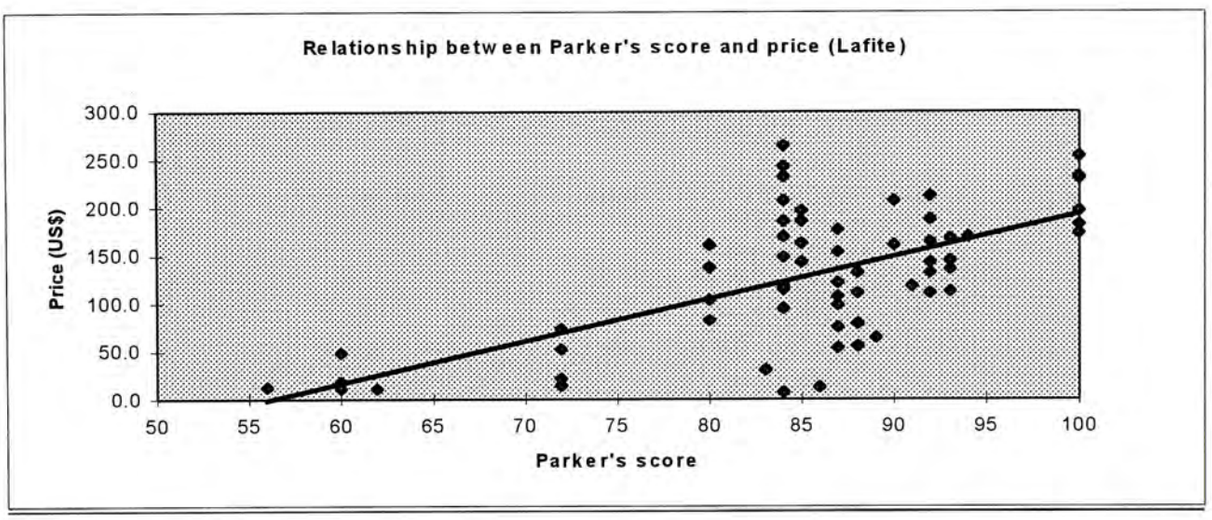

Figure 2B. Relationship between Parker's score and auction prices (Lafite)

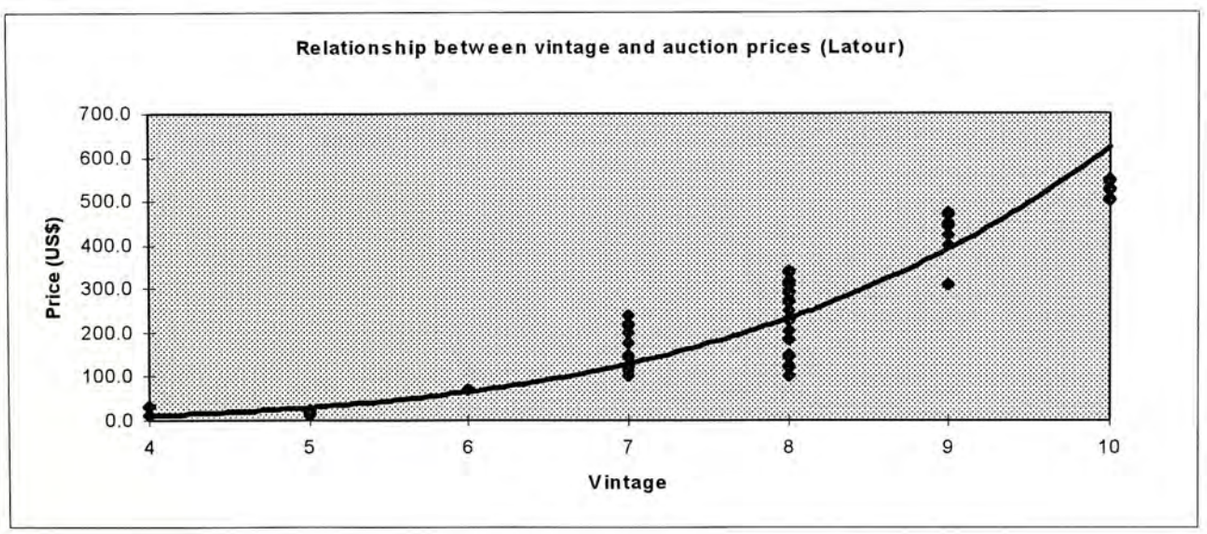

Figure 3A. Relationship between vintage and auction prices (Latour)

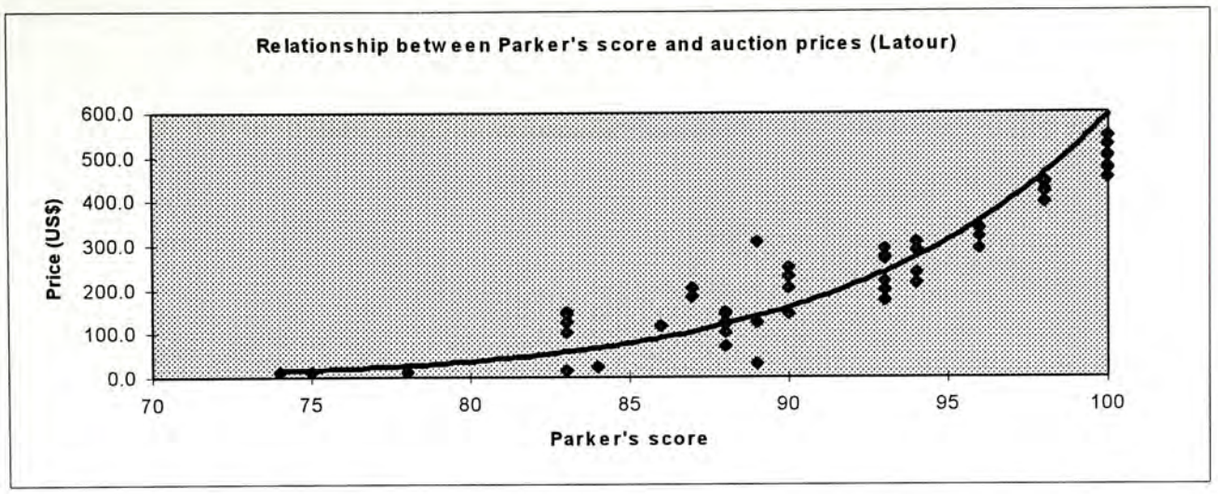

Figure 3B. Relationship between Parker's score and auction prices (Latour)

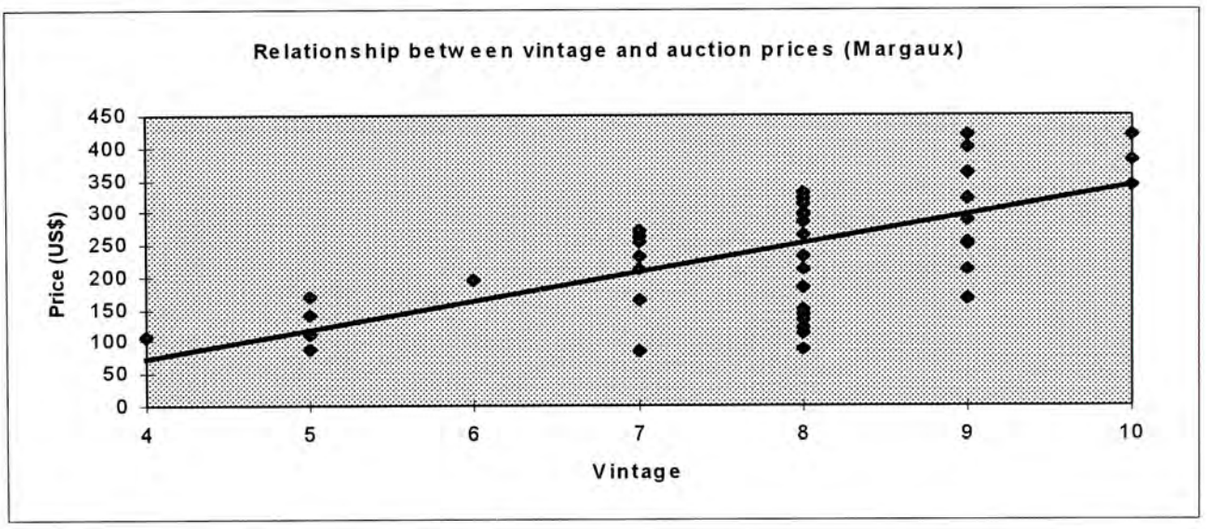

Figure 4A. Relationship between vintage and auction prices (Margaux)

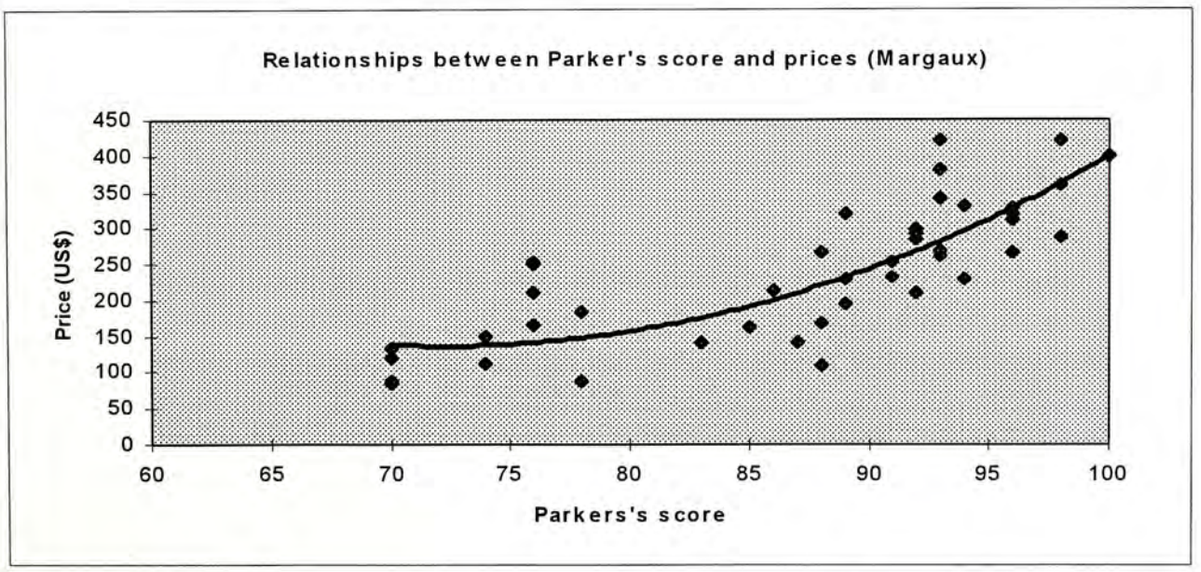

Figure 4B. Relationship between Parker's score and auction prices (Margaux)

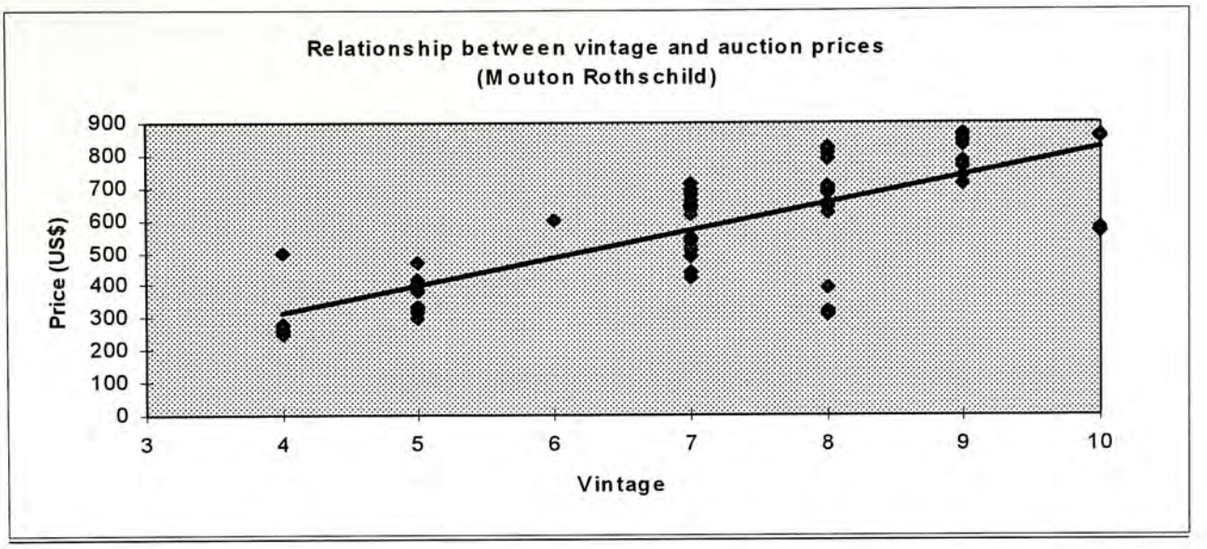

Figure 5A. Relationship between vintage and auction prices (Mouton Rothschild)

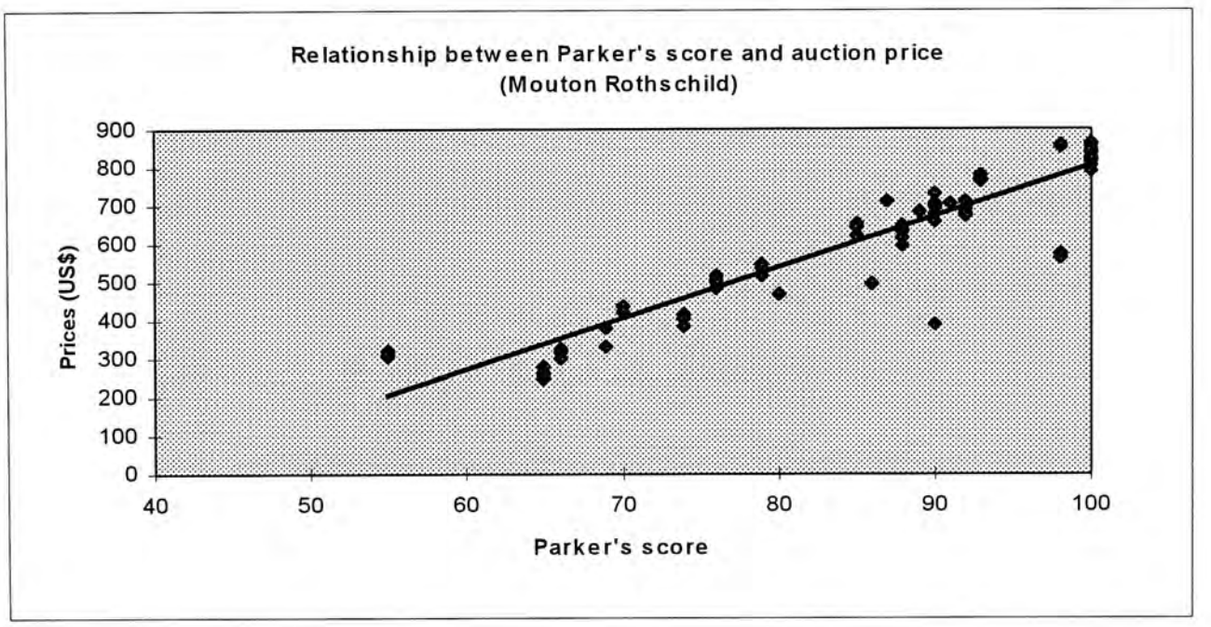

Figure 5B. Relationship between Parker's score and auction prices

(Mouton Rothschild)

From the above figures, one can conclude that Haut Brion, Latour and Margaux may be non-linear. Thus, both linear and non-linear regressions are used for these three wine. The non-linear regression, which named Model 2, is as follows:

$Y= a + b_1X_1 + b_2X_2 + b_3X_1X_2 + b_4X^2_1 + b_5X^2_2 + b_6X_3 + b_7X_4 + b_8X_5$, where

Y= Auction price

X_1= Vintage (X_1 = 1, 2, …, 10)

X_2= Parker's score (X_2 = 50, 51, …, 100)

X_3= Form of offer (In single bottle = 0, In case = 1)

X_4= Ullage (Good =0, Bad =1)

X_5= Label condition (Good=0, Damaged=1)

Data collection and translation

In order to obtain data from all representative auctions, data complied by specialized data provider is used (Blattel and Stainless, 1998). As most of the wine auctions take place in May every year, auction data from May 1997 is used. Besides data from Christie's and Sotheby's, data from other auction houses are also included, for instance, Wermuth, Butterfield and Butterfield are employed.

Vintage. The original data collected is in year. For instance, 1994 is the vintage. However, this provide no information for analysis purpose as older wine, i.e. 1960 wine, is not necessarily better than those of 1970 and vice versa. Hence, a vintage table is used which have a scale of 1-10. Wine from the best vintage is classified as 10 and the worst vintage is classified as 0 with the rest lie in between (Blattel and Stainless, 1998). Vintage table from different sources might be in different absolute values. However, they are complied by referring to the common consensus, i.e. the relative ranking of vintage is the same.

Parker's score. It is a 50-100 point scale that classified as follows:

- 96-100 Extraordinary
- 90-95 Outstanding
- 80-89 Above average to very good
- 70-79 Average

- 50-69 Below average to poor

In explaining his scoring system, Parker explain that he gives every wine a base of 50 points. On top of it, the wine general color and appearance merit up to 5 points. The aroma and bouquet merit up to 15 points. The favor and finish merit up to 20 points. Finally, the overall quality level or potential for further aging merits up to 10 points. While one might argue that Parker's score is related to the "taste" of wine, it might have correlation with vintage since vintage is the input while Parker's score measure the output. It is not necessarily the case because of two reasons: First, wine making is a complicated process and involves many steps. For instance, picking and sorting, destemming and crushing, maceration and pressing, fermentation and malolactic fermentation. Each of these steps can change the final taste of the wine drastically. Second, as a lot of subjective judgments are involved in the Parker's score, especially related to favor and finish, it means good vintage does not necessarily translate into higher score. The use of Parker's score for this exercise aims at testing the impact of critics' evaluation on the auction price of the wine involved.

Form of offer. As a qualitative variable, dummy variables are employed for this factor. If the wine is offer in single bottle, 0 will be assigned. If the wine is offered in bulk, 1 will be assigned.

Ullage. Ullage is a reflection of storage condition, i.e. provenance. As another qualitative variable, dummy variables are also employed in this case. If the ullage is good, 0 will be used. If the ullage is bad, 1 will be used. In treating this factor, we take a simplified approach. It is because ullage is a refined concepts and lots of details are included. For instance, ullage is divided into five levels: into (bottle) neck, bottom neck, top/upper-(bottle) shoulder, mid-shoulder, low-shoulder and below. Into neck is normal level for young wines. In wines over 10 years of age, this level suggests

excellent provenance. Bottom neck is a common fill level at which many chateaux release their wine. For wines of any age, this level suggests excellent provenance. Mid-shoulder may suggest either easing of the cork or inconsistent storage condition while low-shoulder and below suggests poor provenance. For this study, if the ullage of young wine (within 10 years of age) is into neck, we classify it as good ullage. Older wine with bottom neck ullage is also considered as good ullage. Only ullage of mid to low shoulder is considered as bad ullage.

Label condition. Label condition is also a reflection of storage condition which cannot be quantified. For label that is in normal condition, 0 is assigned, for label that is damaged, 1 is used.

CHAPTER 4

FINDINGS

Regression analysis of model 1

First, we are going to state the results on the regressions of the five different wine, i.e. Chateau Lafite, Chateau Latour, Chateau Haut-Brion, Chateau Margaux and Chateau Mouton-Rothschild. Then we will look at the regression analysis on the combined data.

Chateau Lafite

R square	*0.967407*		
Adjusted R square	*0.964691*		
	Degrees of freedom	MS	F
Regression	*5*	*75927.42*	*13.2216*
Residual	*60*	*5742.677*	
	Coefficient	t statistic	P-value
Intercept	*-323.8014*	*-22.39359*	*7.83E-31*
Vintage	*41.01379*	*28.51479*	*1.38E-36*
Parker's score	*1.766978*	*9.695937*	*6.79E-14*
Form of offer	*18.52275*	*4.464053*	*3.61E-05*
Ullage	*-34.93077*	*-9.248587*	*3.78E-13*
Label condition	*-24.24350*	*--6.052583*	*1E-07*

Table 1A. Selected regression statistics on Lafite (Model 1)

The "Coefficient" column of the table gives the multiple regression equation:

$$Y = -323.80 + 41.01X_1 + 1.77X_2 + 18.52X_3 - 34.93X_4 - 24.24X_5$$

The adjusted R square shows that this multiple regression equation explains about 96% of the variations of auction prices. From the F table, we know that the critical value of F (5 degrees of freedom in the numerator, 60 degrees of freedom in the denominator) with a 0.05 level of significance is 2.37. The F value from the table is 13.22, that is greater than the critical value. We reject the null hypothesis that all the coefficients of the population are zero and accept the alternative hypothesis, i.e. the independent variables have the ability to explain the variation in the dependent variable (auction price).

From the Student t table, we know that the critical value of t is +/- 2.00 with 60 degrees of freedom (0.05 level of significance in two tail). Since t values of all the independent variables are greater than +2.00 or lesser than -2.00, we reject the null hypothesis that each of them is equal to zero and accept the alternative hypothesis that all of them have the ability to explain the variation in the dependent variable (auction price).

Chateau Latour

R square	*0.90873885*		
Adjusted R square	*0.90125842*		
	Degrees of freedom	MS	F
Regression	*5*	*28255.15*	*121.4823*
Residual	*61*	*2325.865*	
	Coefficient	t statistic	P-value
Intercept	*-1229.3759*	*-12.06777*	*8.31E-18*
Vintage	*47.3245294*	*7.046238*	*1.93E-09*
Parker's score	*12.2571488*	*8.137144*	*2.56E-11*
Form of offer	*24.8369041*	*1.501636*	*0.13835*
Ullage	*-2.5041195*	*-0.193622*	*0.847115*
Label condition	*-37.945944*	*-2.2318*	*0.029312*

Table 1B. Selected regression statistics on Latour (Model 1)

The "Coefficient" column of the table gives the multiple regression equation:

$Y = -1229.38 + 47.32X_1 + 12.26X_2 + 24.84X_3 - 2.50X_4 - 37.95X_5$

The adjusted R square shows that this multiple regression equation explains about 90% of the dependent variable. From the F table, we know that the critical value of F (5 degrees of freedom in the numerator, 61 degrees of freedom in the denominator) with a 0.05 level of significance is 2.37. The F value from the table is 121.48, that is greater than the critical value. We reject the null hypothesis that all the coefficients of the population are zero and accept the alternative hypothesis.

From the Student t table, we know that the critical value of t is +/- 2.00 with 61 degrees of freedom (0.05 level of significance in two tail). Since t values of intercept, vintage, Parker's score and label condition are greater than +2.00 or lesser

than -2.00, we reject the null hypothesis that each of them is equal to zero and accept the alternative hypothesis that each of them have the ability to explain the variation in the dependent variable (auction price). However, the t values of form of offer and ullage are less than +2.00 or greater than -2.00. Hence, we accept the null hypothesis that each of these variables have no prediction power to the regression equation.

The reason that form of offer and ullage have no prediction power can be attributed to the shortage of Latour in some particular vintages. For example, 1967 and 1976 which are considered as bad vintage. Due to their inferior quality relative to other years, their turnover is particularly thin that renders the hammer prices not representative. In fact, in order to complete their collections, i.e. to cover wine that produced every year, collectors are willing to pay for amount that is higher than the "fair price" despite the wine is in less than desire condition.

Chateau Haut Brion

R square	*0.915607*		
Adjusted R square	*0.90556*		
	Degrees of freedom	MS	F
Regression	*5*	*97255.23742*	*91.133811*
Residual	*42*	*1067.169653*	
	Coefficient	t statistic	P-value
Intercept	*-1168.234*	*-13.0929679*	*2.028E-16*
Vintage	*44.04758*	*7.467074082*	*3.145E-09*
Parker's score	*10.72184*	*8.7817004176*	*4.673E-11*
Form of offer	*13.71201*	*0.87707728*	*0.3854341*
Ullage	*-17.3941*	*-1.55324263*	*0.127869*
Label condition	*-5.541792*	*-0.49000366*	*0.6266813*

Table 1C. Selected regression statistics on Haut Brion (Model 1)

The "Coefficient" column of the table gives the multiple regression equation:

$Y = -1168.23 + 44.05X1 + 10.72X2 + 13.71X3 - 17.39X4 - 5.54X5$

The adjusted R square shows that this multiple regression equation explains about 90% of the dependent variable. From the F table, we know that the critical value of F (5 degrees of freedom in the numerator, 42 degrees of freedom in the denominator) with a 0.05 level of significance is 2.45. The F value from the table is 91.13, that is greater than the critical value. We reject the null hypothesis that all the coefficients of the population are zero and accept the alternative hypothesis, i.e. the independent variables have the ability to explain the variation in the dependent variable (auction price).

From the Student t table, we know that the critical value of t is +/- 2.021 with 42 degrees of freedom (0.05 level of significance in two tail). Since t values of intercept, vintage and Parker's score are greater than +2.021 or lesser than -2.021, we reject the null hypothesis that each of them is equal to zero and accept the alternative hypothesis that each of them have the ability to explain the variation in the dependent variable (auction price). However, the t values of form of offer, ullage and label damage are less than +2.021 or greater than -2.021. Hence, we accept the null hypothesis that each of these variables have no prediction power to the regression equation.

Again, the reason that form of offer, ullage and label damage have no prediction power can be attributed to the shortage of Haut Brion in some particular vintages. However, this time it is due to the shortage of 1961 which is considered one of the best vintage for the past forty years. In fact, in order to complete their collections, i.e. to cover wine that produced every year, collectors are willing to pay for amount that is higher than the "fair price" despite the wine is in less than desire condition.

Chateau Margaux

R square	*0.977877*		
Adjusted R square	*0.975111*		
	Degrees of freedom	MS	F
Regression	*5*	*81875.69*	*353.6117*
Residual	*40*	*231.5412*	
	Coefficient	t statistic	P-value
Intercept	*-678.0478*	*-27.33625*	*1.69E-27*
Vintage	*38.8584*	*21.56779*	*1.22E-23*
Parker's score	*7.227755*	*28.2469*	*4.85E-28*
Form of offer	*36.09929*	*3.640646*	*0.000771*
Ullage	*-8.945447*	*-1.647585*	*0.107272*
Label condition	*-54.14937*	*-9.435102*	*1.01E-11*

Table 1D. Selected regression statistics on Margaux (Model 1)

The "Coefficient" column of the table gives the multiple regression equation:

$Y = -678.048 + 38.86X_1 + 7.23X_2 + 36.10X_3 - 8.95X_4 - 54.15X_5$

The adjusted R square shows that this multiple regression equation explains about 98% of the dependent variable. From the F table, we know that the critical value of F (5 degrees of freedom in the numerator, 40 degrees of freedom in the denominator) with a 0.05 level of significance is 2.45. The F value from the table is 353.6117, that is greater than the critical value. We reject the null hypothesis that all the coefficients of the population are zero and accept the alternative hypothesis, i.e. the independent variables have the ability to explain the variation in the dependent variable (auction price).

From the Student t table, we know that the critical value of t is +/- 2.021 with 40 degrees of freedom (0.05 level of significance in two tail). Since t values of intercept, vintage, Parker's score, form of offer and label condition are greater than +2.021 or lesser than -2.021, we reject the null hypothesis that each of them is equal to zero and accept the alternative hypothesis that all of them have the ability to explain the variation in the dependent variable (auction price).

However, the t value of ullage is greater than -2.021. Hence, we accept the null hypothesis that ullage has no prediction power to the regression equation.

This is due to the fact that the bad ullage is concentrated in particular vintages that are considered to be the worst. It is believed that bidders have discounted the effect of the bad vintage, if they further discount the bad ullage, the price will be considered as "too low" for First Growth wine. Thus, this "minimum price effect" renders the ullage factor ineffective.

Chateau Mouton Rothschild

R square	*0.884521*		
Adjusted R square	*0.877022*		
	Degrees of freedom	MS	F
Regression	*5*	*446982*	*117.9575*
Residual	*77*	*3789.344*	
	Coefficient	t statistic	P-value
Intercept	*-520.9113*	*-9.624129*	*7.57E-15*
Vintage	*29.23392*	*4.738796*	*9.65E-06*
Parker's score	*10.78469*	*13.78069*	*1.75E-22*
Form of offer	*11.57165*	*0.819091*	*0.415263*
Ullage	*-33.45307*	*-2.262962*	*0.026456*
Label condition	*-2.179536*	*-0.120523*	*0.904383*

Table 1E. Selected regression statistics on Mouton Rothschild (Model 1)

The "Coefficient" column of the table gives the multiple regression equation:

$Y = -520.91 + 29.23X_1 + 10.78X_2 + 11.57X_3 - 33.45X_4 - 2.18X_5$

The adjusted R square shows that this multiple regression equation explains about 88% of the dependent variable. From the F table, we know that the critical value of F (5 degrees of freedom in the numerator, 77 degrees of freedom) with a 0.05 level of significance is 2.37. The F value from the table is 117.958, that is greater than the critical value. We reject the null hypothesis that all the coefficients of the population are zero and accept the alternative hypothesis, i.e. the independent variables have the ability to explain the variation in the dependent variable (auction price).

From the Student t table, we know that the critical value of t is +/- 2.00 with 77 degrees of freedom (0.05 level of significance with two tail). Since t values of

intercept, vintage, Parker's score and ullage are greater than +2.00 or lesser than -2.00, we reject the null hypothesis that each of them is equal to zero and accept the alternative hypothesis that all of them have the ability to explain the variation in the dependent variable (auction price). However, t values of form of offer and label damage are less than +2.00 or greater than -2.00. Hence, we accept the null hypothesis that each of these variables have no prediction power to the regression equation.

This is due to the fact that the single-bottle offer and label damage is concentrated in particular vintages that are considered to be the worst. It is believed that bidders have discounted the effect of the bad vintage, if they further discount single-bottle offer and label damage, the price will be considered as "too low" for First Growth wine. Thus, this "minimum price effect" renders these two factors ineffective.

Combined Data

R square	*0.943051*		
Adjusted R square	*0.941147*		
	Degrees of freedom	MS	F
Regression	*10*	*1536980*	*495.1354*
Residual	*299*	*3104.162*	
	Coefficient	t statistic	P-value
Intercept	*-946.2933*	*-2.68E-06*	*0.999998*
Vintage	*45.99218*	*16.45645*	*9E-44*
Parker's score	*7.52505*	*18.08526*	*6.6E-50*
Form of offer	*18.05797*	*2.208818*	*0.027946*
Ullage	*-26.92396*	*-4.002451*	*7.91E-05*
Label condition	*-19.621*	*-2.534823*	*0.01176*
Haut Brion	*65.79194*	*1.86E-07*	*1*
Lafite	*88.2512*	*2.5E-07*	*1*
Latour	*167.5871*	*4.74E-07*	*1*
Margaux	*181.7067*	*5.14E-07*	*1*
Mouton Rothschild	*585.1429*	*1.66E-06*	*0.9999*

Table 1F. Selected regression statistics on Combined Data (Model 1)

The "Coefficient" column of the table gives the multiple regression equation:

$$Y = -946.2933 + 45.99X_1 + 7.53X_2 + 18.06X_3 - 26.92X_4 - 19.62X_5 + 65.79X_6 + 88.25X_7 + 167.59X_8 + 181.71X_9 + 585.14X_{10}$$

This multiple regression equation differs from the previous ones in the addition of the following independent variables:

X_6= Haut Brion (No =0, Yes =1)

X_7= Lafite (No =0, Yes =1)

X_8= Latour (No =0, Yes =1)

X_9= Margaux (No =0, Yes =1)

X_{10}= Mouton Rothschild (No =0, Yes =1)

These variables are added in order to investigate the effect of individual brand on the auction price besides the factors mentioned before.

The Adjusted R Square shows that this multiple regression equation explains about 94% of the dependent variable. From the F table, we know that the critical value of F (10 degrees of freedom in the numerator, 299 degrees of freedom in the denominator) with a 0.05 level of significance is 1.83. The F value from the table is 495.1354, that is greater than the critical value. We reject the null hypothesis that all the coefficients of the population are zero and accept the alternative hypothesis, i.e. the independent variables have the ability to explain the variation in the dependent variable (auction price).

From the Student t table, we know that the critical value of t is +/- 1.96 with 299 degrees of freedom (0.05 level of significance in two tail). Since t values of vintage, Parker's score, form of offer, ullage and label condition are greater than +1.96 or lesser than -1.96, we reject the null hypothesis that each of them is equal to zero and accept the alternative hypothesis that all of them have the ability to explain the variation in the dependent variable (auction price). However, the t value of the intercept, Haut Brion, Lafite, Latour, Margaux and Mouton Rothschild are greater than -1.96. Hence, we accept the null hypothesis that these variables cannot explain the variation of the dependent variable, i.e. auction price.

By including the brand name effect, the prediction power of the regression equation is much greater than that of excluding the brand name effect, i.e 94% R square versus 37% R square. However, each brand name cannot explain the auction price if it is considered as a stand alone factor. It proves the conventional wisdom that brand name should not be the sole determinant in purchasing of wine. After all, fundamentals like vintage and ullage should taken into account.

Results on Model 2 (non-linear regression)

Chateau Haut Brion

R square	*0.984232*		
Adjusted R square	*0.980998*		
	Degrees of freedom	MS	F
Regression	*8*	*65340.4*	*304.3034*
Residual	*39*	*214.7212*	
	Coefficient	t statistic	P-value
Intercept	*2233.347*	*2.741773*	*0.009177*
Vintage	*-127.4717*	*-2.178977*	*0.035439*
Parker's score	*-49.07238*	*-2.201405*	*0.033691*
Vintage*Parker's score	*1.223119*	*1.510264*	*0.139037*
Vintage^2	*4.038816*	*1.779547*	*0.082944*
Parker's score^2	*0.271807*	*1.816116*	*0.077046*
Form of offer	*-6.017429*	*-0.825601*	*0.414052*
Ullage	*-20.35065*	*-4.017456*	*0.00026*
Label condition	*-9.726799*	*-1.908319*	*0.063731*

Table 2A. Selected regression statistics on Haut Brion (Model 2)

The "Coefficient" column of the table gives the multiple regression equation:

$$Y = 2233.35 - 127.47X_1 - 49.07X_2 + 1.22X_1X_2 + 4.04X^2_1 + 0.27X^2_2 - 6.02X_3 - 20.35X_4 - 9.73X_5$$

The adjusted R square shows that this multiple regression equation explains about 98% of the dependent variable. From the F table, we know that the critical value of F (8 degrees of freedom in the numerator, 39 degrees of freedom in the denominator) with a 0.05 level of significance is 2.18. The F value from the table is 304.3034, that is greater than the critical value. We reject the null hypothesis that all the coefficients of the population are zero and accept the alternative hypothesis, i.e. the independent variables have the ability to explain the variation in the dependent variable (auction price).

From the Student t table, we know that the critical value of t is +/- 2.021 with 39 degrees of freedom (0.05 level of significance in two tail). Since t values of intercept, vintage, Parker's score and ullage are greater than +2.021 or lesser than -2.021, we reject the null hypothesis that each of them is equal to zero and accept the alternative hypothesis that all of them have the ability to explain the variation in the dependent variable (auction price). However, the t values of vintage*Parker's score, vintage^2, Parker's score^2, form of offer and label condition are less than +2.00 or greater than -2.00. Hence, we accept the null hypothesis that they have no prediction power to the regression equation.

Chateau Latour

R square	*0.986536*		
Adjusted R square	*0.984619*		
	Degrees of freedom	MS	F
Regression	*8*	*191713*	*531.2388*
Residual	*58*	*360.8792*	
	Coefficient	t statistic	P-value
Intercept	*2521.097*	*4.315007*	*6.29E-05*
Vintage	*-117.3467*	*-2.412786*	*0.019013*
Parker's score	*-59.3039*	*-3.580431*	*0.000702*
Vintage*Parker's score	*1.548596*	*2.163955*	*0.034599*
Vintage^2	*2.102732*	*1.257575*	*0.213585*
Parker's score^2	*0.337557*	*2.871589*	*0.005694*
Form of offer	*5.946259*	*0.900337*	*0.371664*
Ullage	*-12.19479*	*-2.372682*	*0.020996*
Label condition	*-28.91559*	*-4.298802*	*6.65E-05*

Table 2B. Selected regression statistics on Latour (Model 2)

The "Coefficient" column of the table gives the multiple regression equation:

$Y= 2521.10 - 117.35X_1 - 59.30X_2 + 1.55X_1X_2 + 2.10X^2_1 - 0.34\,X^2_2 + 5.95X_3 - 12.19X_4 - 28.92X_5$

The adjusted R square shows that this multiple regression equation explains about 98% of the dependent variable. From the F table, we know that the critical value of F (8 degrees of freedom in the numerator, 58 degrees of freedom in the denominator) with a 0.05 level of significance is 2.10. The F value from the table is 531.2388, that is greater than the critical value. We reject the null hypothesis that all

the coefficients of the population are zero and accept the alternative hypothesis, i.e. the independent variables have the ability to explain the variation in the dependent variable (auction price).

From the Student t table, we know that the critical value of t is +/- 2.10 with 58 degrees of freedom (0.05 level of significance in two tail). Since t values of intercept, vintage, Parker's score, vintage*Parker's score, Parker's score^2 ,ullage and label condition are greater than +2.00 or lesser than -2.00, we reject the null hypothesis that each of them is equal to zero and accept the alternative hypothesis that all of them have the ability to explain the variation in the dependent variable (auction price). However, the t values of vintage^2 and form of offer are less than +2.00. Hence, we accept the null hypothesis that they have no prediction power to the regression equation.

Chateau Margaux

R square	*0.979607*		
Adjusted R square	*0.975198*		
	Degrees of freedom	MS	F
Regression	*8*	*51262.87*	*222.1736*
Residual	*37*	*230.7334*	
	Coefficient	t statistic	P-value
Intercept	*-619.7803*	*-2.055655*	*0.046924*
Vintage	*19.71681*	*0.690649*	*0.494096*
Parker's score	*7.335984*	*1.154022*	*0.255891*
Vintage*Parker's score	*-0.065922*	*-0.189208*	*0.850964*
Vintage^2	*1.750586*	*1.699378*	*0.097642*
Parker's score^2	*0.002227*	*0.053751*	*0.957423*
Form of offer	*30.98029*	*3.004119*	*0.004758*
Ullage	*-8.092844*	*-1.476984*	*0.148142*
Label condition	*-58.09677*	*-9.503847*	*1.8E-11*

Table 2C. Selected regression statistics on Margaux (Model 2)

The "Coefficient" column of the table gives the multiple regression equation:

$Y = -619.78 + 19.72X_1 + 7.34X_2 - 0.06X_1X_2 + 1.75X^2_1 + 0.002\,X^2_2 + 30.98X_3 - 8.09X_4 - 58.10X_5$

The adjusted R square shows that this multiple regression equation explains about 98% of the dependent variable. From the F table, we know that the critical value of F (8 degrees of freedom in the numerator, 37 degrees of freedom in the denominator) with a 0.05 level of significance is 2.18. As the F value from the table is 222.1736, that is greater than the critical value. We reject the null hypothesis that all

the coefficients of the population are zero and accept the alternative hypothesis, i.e. the independent variables have the ability to explain the variation in the dependent variable (auction price).

From the Student t table, we know that the critical value of t is +/- 2.18 with 37 degrees of freedom (0.05 level of significance and two tail). Since t values of intercept, form of offer and label condition are greater than +2.18 or lesser than -2.18, we reject the null hypothesis that each of them is equal to zero and accept the alternative hypothesis that all of them have the ability to explain the variation in the dependent variable. However, the t values of vintage, Parker's score, vintage*Parker's score, vintage^2, Parker's score^2 and ullage are less than +2.18 or greater than -2.18. Hence, we accept the null hypothesis they have no prediction power to the regression equation.

CHAPTER 5

CONCLUSION AND IMPLICATIONS

From the findings stated in the previous chapter, we can conclude that the factors as a group (vintage, Parker's score, form of offer, ullage and label condition) can explain the variations of auction price (as shown by the adjusted R square) and the multiple regression model 1 and 2 are valid (as shown by the F test). However, we suggest bidders to do adjustments according to our statistical findings. It is because of the following observations and their implications:

- Not all the factors "work" for every wine. For instance, from the result of the t-test, ullage is not a significant predictor of auction price of Margaux in model 1. The following table shows which factors do not have prediction power for each of the five red wine in model 1 and model 2 respectively:

	Factors which have no prediction power (Model 1)	Factors which have no prediction power (Model 2)
Lafite	*N/A*	*Not applicable*
Latour	*Form of offer; Ullage*	*From of offer; Vintage^2*
Haut Brion	*Form of offer; Ullage, Label condition*	*Vintage*Parker's score; Vintage^2; Parker's score^2; form of offer;label condition*
Margaux	*Ullage*	*Parker's score; vintage; vintage*Parker's score; vintage^2; Parker's score^2, ullage*
M-Rothschild	*Offer; label damage*	*Not applicable*

Table 3. Factors that have no prediction power

The possible reasons of why the factors listed above do not have prediction power is explained earlier in the findings section. Most of them are due to the imbalance of supply and demand of a particular vintage. We suggest bidders to exclude the above factors corresponding to each wine when constructing the regression models listed in the findings section.

At first glance, model 2 (non-linear model) seems to have higher prediction power than model 1(linear model) as shown by the table below. However, the coefficients of the intercepts are not statistical significant. It makes us skeptical in using model 2. For Margaux, the difference in adopting the two model is minimal. Hence, it also depends on which wine we analyze when we choose the model.

	Model 1 (Linear)	Model 2 (Non-linear)
Lafite	*96.5%*	*Not applicable*
Latour	*90.1%*	*98.5%*
Haut Brion	*90.6%*	*98.1%*
Margaux	*97.5%*	*97.5%*
Mouton Rothschild	*87.7%*	*Not applicable*

Table 4. Adjusted R square for each of the five wine

From the table above, we suggest using model 1 for Lafite, Margaux and Mouton Rothschild and using model 2 for Latour and Haut Brion.

Finally, doubts might be raised when readers observe that the intercepts of regressions for model 1 are all carrying negative value, i.e. the wine merchant will have to pay people to buy wines which are of zero vintage and Parker's score. It is theoretically possible but it will never happen in real life. It is because vintage of the past 30 years had hardly below 3 and the minimum Parker's score is 50.

APPENDIX

Appendix 1 Raw data collected

HAUT BRION

Vintage	Parker's score	Offer	Ullage	Label condition	Unit price (in US$)
10	100	1	0	1	373
10	100	1	1	1	350
10	100	1	0	0	377
10	100	0	0	1	380
10	100	0	1	1	356
10	100	0	1	0	370
7	88	0	0	1	40
7	88	0	1	0	50
8	90	0	0	1	140
8	90	0	1	1	132
8	86	1	0	1	90
8	86	0	0	1	75
8	86	0	1	0	56
9	85	0	0	1	138
9	85	0	1	1	111
9	85	0	1	0	131
7	88	0	0	1	60
7	88	0	1	1	34
7	88	0	1	0	50
5	76	0	0	1	10
8	93	1	0	1	169
8	93	0	0	1	175
8	93	0	1	1	145
8	93	0	1	0	166
8	86	0	0	1	93
8	86	0	1	1	66
8	86	0	0	0	92
8	90	0	0	1	140
8	90	0	0	1	139
7	93	0	0	1	99
7	93	0	1	0	109
7	85	0	0	1	23
9	94	1	0	1	235
9	94	0	0	1	230
9	94	0	0	0	246
8	87	0	0	1	85
8	87	0	0	0	105
5	84	0	0	1	20
8	94	0	0	1	168
8	94	0	0	0	185
8	96	0	0	1	191
8	96	0	0	0	210
7	88	0	0	1	57
8	91	0	0	1	152
9	100	0	0	1	325
9	96	0	0	1	270
6	90	0	0	1	25
8	93	0	0	1	176

LAFITE

Vintage	Parker's score	Offer	Ullage	Label condition	Unit price (in US$)
10	84	1	0	0	265.0
10	84	1	1	0	233.0
10	84	0	0	0	242.0
10	84	0	1	0	208.0
10	84	0	1	1	185.0
7	88	1	0	0	132.0
7	88	0	0	0	110.0
7	88	0	1	0	78.0
7	88	0	1	1	56.0
8	80	1	0	0	161.0
8	80	0	0	0	138.0
8	80	0	1	0	104.0
8	80	0	1	1	83.0
8	84	1	0	0	170.0
8	84	1	1	1	117.0
8	84	0	0	0	148.0
8	84	0	1	0	115.0
8	84	0	1	1	94.0
7	72	0	0	0	74.0
7	72	0	0	1	52.0
7	72	0	1	1	21.0
5	62	0	0	0	10.0
9	85	1	1	0	185.0
9	85	0	0	0	196.0
9	85	0	1	0	163.0
9	85	0	1	1	142.0
7	60	0	0	0	49.0
7	60	0	1	0	17.0
7	60	0	1	1	11.0
4	72	0	0	0	15.0
5	56	0	0	0	12.0
8	92	0	0	0	188.0
8	92	1	0	0	165.0
8	92	1	1	0	133.0
8	92	1	0	1	143.0
8	92	0	1	1	111.0
8	93	0	0	0	167.0
8	93	0	1	0	135.0
8	93	0	1	1	112.0
8	87	1	0	0	177.0
8	87	0	0	0	154.0
8	87	0	1	0	122.0
8	87	0	1	1	99.0
7	87	0	0	0	107.0
7	87	0	1	0	75.0
7	87	0	1	1	53.0
5	83	0	0	0	30.0
7	91	0	0	0	117.0
9	100	1	0	0	253.0
9	100	1	0	1	232.0
9	100	0	0	0	230.0
9	100	0	1	0	197.0
9	100	0	1	1	174.0
8	93	0	0	0	167.0
8	93	0	0	1	145.0
5	84	0	0	0	7.0
8	87	0	0	0	154.0
8	100	0	0	0	183.0
7	87	0	0	0	107.0
8	94	0	0	0	170.0
9	90	0	0	0	208.0
9	92	0	0	0	212.0
4	86	0	0	0	12.0
6	89	0	0	0	65.0
7	88	0	0	0	110.0
8	90	0	0	0	161.0

LATOUR

Vintage	Parker's score	Offer	Ullage	Label condition	Unit price (in US$)
10	100	1	0	0	547.0
10	100	1	1	0	527.0
10	100	1	1	1	503.0
10	100	0	0	0	545.0
10	100	0	1	0	525.0
10	100	0	1	1	500.0
7	94	1	0	0	237.0
7	94	0	1	0	214.0
8	90	1	0	0	251.0
8	90	1	1	0	231.0
8	90	0	0	0	249.0
8	90	0	1	0	228.0
8	90	0	1	1	204.0
8	96	1	0	0	340.0
8	96	0	0	0	338.0
8	96	0	1	0	318.0
8	96	0	1	1	293.0
7	88	1	0	0	147.0
7	88	0	0	0	145.0
7	88	0	1	0	125.0
7	88	0	1	1	101.0
5	74	0	0	0	11.0
5	74	0	1	0	13.0
9	98	1	0	0	444.0
9	98	1	1	0	423.0
9	98	0	0	0	442.0
9	98	0	1	0	421.0
9	98	0	1	1	397.0
7	93	0	0	0	220.0
7	93	0	1	0	200.0
7	93	0	1	1	175.0
4	75	0	0	0	12.0
4	78	0	0	0	11.0
4	78	0	1	0	11.0
8	93	0	0	0	293.0
8	93	0	1	0	273.0
8	93	1	0	1	269.0
8	83	0	0	0	147.0
8	83	0	0	0	145.0
8	83	0	1	0	124.0
8	83	0	1	1	100.0
8	94	0	0	0	308.0
8	94	0	1	0	288.0
8	94	0	1	0	288.0
7	88	0	0	0	145.0
7	88	0	1	0	125.0
7	88	0	0	1	121.0
5	83	0	0	0	14.0
7	88	0	0	0	145.0
7	88	0	1	1	101.0
9	100	1	0	0	474.0
9	100	0	0	0	471.0
9	100	0	1	0	451.0
8	87	0	0	0	204.0
8	87	0	1	0	184.0
5	84	0	0	0	23.0
8	87	0	0	0	204.0
8	90	0	0	0	249.0
8	90	0	1	0	228.0
7	86	0	0	0	115.0
8	89	0	0	0	123.0
9	89	0	0	0	308.0
9	98	0	0	0	442.0
4	89	0	0	0	33.0
6	88	0	0	0	71.0
7	90	0	0	0	145.0
8	94	0	0	0	308.0

MARGAUX

Vintage	Parker's score	Offer	Ullage	Label condition	Unit price (in US$)
10	93	1	0	0	420
10	93	0	0	0	381
10	93	0	1	1	340
7	85	0	1	1	162
8	78	0	0	0	184
8	83	0	1	1	142
9	76	1	0	0	252
9	76	0	0	0	251
9	76	0	1	0	210
9	76	0	1	1	165
7	70	0	0	0	85
8	74	0	0	0	150
8	74	0	1	1	112
8	70	0	0	0	120
8	70	0	1	0	132
8	70	0	1	1	88
5	78	0	1	0	88
8	92	0	0	0	298
8	92	0	1	0	285
8	92	0	1	1	210
7	93	0	0	0	262
7	93	0	1	0	269
5	88	0	0	0	168
5	88	0	0	1	110
7	91	0	0	0	254
7	91	0	1	0	232
9	98	1	0	0	420
9	98	0	0	0	420
9	98	0	1	0	360
9	98	0	1	1	287
8	96	0	0	0	328
8	96	0	1	0	311
8	96	0	1	1	265
5	87	0	0	0	141
8	94	0	0	0	330
8	94	0	0	1	230
8	96	0	0	0	320
8	96	0	1	0	311
7	86	0	0	0	212
8	88	0	0	0	265
9	89	0	0	0	320
9	100	0	0	0	400
4	88	0	0	0	106
6	89	0	0	0	195
7	89	0	0	0	230
8	92	0	0	0	294

MOUTON ROTHSCHILD

Vintage	Parker's score	Offer	Ullage	Label condition	Unit price (in US$)
10	98	0	0	1	572
10	98	0	1	1	555
10	98	0	1	0	576
10	98	1	0	1	560
10	98	1	1	0	564
7	92	0	0	1	690
7	92	0	1	1	673
7	92	0	0	0	710
7	92	1	0	1	676
8	55	0	0	1	322
8	55	0	1	1	305
8	55	1	1	0	313
8	90	0	0	1	704
8	90	0	0	1	704
8	90	0	1	1	390
7	70	1	0	1	436
7	70	1	0	1	436
7	70	1	1	1	419
9	93	0	0	1	779
9	93	0	1	1	762
9	93	1	0	1	767
9	93	0	1	1	752
9	93	1	1	0	770
7	88	0	0	1	646
7	88	1	0	1	634
7	88	1	1	1	617
4	65	0	0	1	277
4	65	0	1	1	260
4	65	1	0	1	265
4	65	1	1	1	248
5	69	0	0	0	380
5	69	0	0	0	380
5	69	1	1	1	331
8	90	0	0	1	707
8	90	1	0	1	695
8	90	1	1	1	678
8	90	1	1	0	696
8	85	1	0	1	640
8	85	1	1	1	623
8	85	1	1	0	643
5	66	0	0	1	327
5	66	1	0	1	315
5	66	1	1	1	298
8	85	0	0	1	652
8	85	1	0	1	640
8	85	1	1	1	623
8	85	1	1	0	643
7	76	0	0	1	514
7	76	1	0	1	502
7	76	1	1	1	485
7	76	1	1	0	505
5	74	0	0	1	415
5	74	1	0	1	403
5	74	1	1	1	386
7	79	0	0	1	547
7	79	1	0	1	535
7	79	1	1	1	518
9	100	0	0	1	856
9	100	0	1	1	839
9	100	1	0	1	844
9	100	1	1	1	827
9	100	1	0	0	864
9	100	1	1	0	847
8	90	0	0	1	707
8	90	1	0	1	695
8	90	1	1	0	698
5	80	1	0	1	469
8	90	0	0	1	707
8	90	1	0	1	695

8	90	1	1	0	698
5	80	1	0	1	469
8	90	0	0	1	707
8	90	1	0	1	695
8	90	1	1	1	678
8	100	0	0	1	617
8	100	0	1	0	820
8	100	1	0	1	805
8	100	1	1	1	788
8	100	1	0	0	825
7	88	1	0	1	637
8	89	1	0	1	684
9	90	1	0	1	734
9	87	0	0	1	713
4	86	1	0	1	496
6	88	1	0	1	596
7	90	1	0	1	656
8	91	1	0	1	706

COMBINED DATA

Vintage	Parker's score	Offer	Ullage	Label condition	Haut Brion	Lafite	Latour	Margaux	Mouton Rothschild	Unit price (in US$)
10	100	1	0	1	1	0	0	0	0	373
10	100	1	1	1	1	0	0	0	0	350
10	100	1	0	0	1	0	0	0	0	377
10	100	0	0	1	1	0	0	0	0	380
10	100	0	1	1	1	0	0	0	0	356
10	100	0	1	0	1	0	0	0	0	370
7	88	0	0	1	1	0	0	0	0	40
7	88	0	1	0	1	0	0	0	0	50
8	90	0	0	1	1	0	0	0	0	140
8	90	0	1	1	1	0	0	0	0	132
8	86	1	0	1	1	0	0	0	0	90
8	86	0	0	1	1	0	0	0	0	75
8	86	0	1	0	1	0	0	0	0	66
9	85	0	0	1	1	0	0	0	0	138
9	85	0	1	1	1	0	0	0	0	111
9	85	0	1	0	1	0	0	0	0	131
7	88	0	0	1	1	0	0	0	0	60
7	88	0	1	1	1	0	0	0	0	34
7	88	0	1	0	1	0	0	0	0	50
5	76	0	0	1	1	0	0	0	0	10
8	93	1	0	1	1	0	0	0	0	169
8	93	0	0	1	1	0	0	0	0	175
8	93	0	1	1	1	0	0	0	0	145
8	93	0	1	0	1	0	0	0	0	166
8	86	0	0	1	1	0	0	0	0	93
8	86	0	1	1	1	0	0	0	0	66
8	86	0	0	0	1	0	0	0	0	92
8	90	0	0	1	1	0	0	0	0	140
8	90	0	0	1	1	0	0	0	0	139
7	93	0	0	1	1	0	0	0	0	99
7	93	0	1	0	1	0	0	0	0	109
7	85	0	0	1	1	0	0	0	0	23
9	94	1	0	1	1	0	0	0	0	235
9	94	0	0	1	1	0	0	0	0	230
9	94	0	0	0	1	0	0	0	0	246
8	87	0	0	1	1	0	0	0	0	85
8	87	0	0	0	1	0	0	0	0	105
5	84	0	0	1	1	0	0	0	0	20
8	94	0	0	1	1	0	0	0	0	168
8	94	0	0	0	1	0	0	0	0	185
8	96	0	0	1	1	0	0	0	0	191
8	96	0	0	0	1	0	0	0	0	210
7	88	0	0	1	1	0	0	0	0	57
8	91	0	0	1	1	0	0	0	0	152
9	100	0	0	1	1	0	0	0	0	325
9	96	0	0	1	1	0	0	0	0	270
6	90	0	0	1	1	0	0	0	0	25
8	93	0	0	1	1	0	0	0	0	176
10	84	1	0	0	0	1	0	0	0	265.0
10	84	1	1	0	0	1	0	0	0	233.0
10	84	0	0	0	0	1	0	0	0	242.0
10	84	0	1	0	0	1	0	0	0	206.0
10	84	0	1	1	0	1	0	0	0	185.0
7	88	1	0	0	0	1	0	0	0	132.0
7	88	0	0	0	0	1	0	0	0	110.0
7	88	0	1	0	0	1	0	0	0	78.0
7	88	0	1	1	0	1	0	0	0	56.0
8	80	1	0	0	0	1	0	0	0	161.0
8	80	0	0	0	0	1	0	0	0	136.0
8	80	0	1	0	0	1	0	0	0	104.0
8	80	0	1	1	0	1	0	0	0	83.0
8	84	1	0	0	0	1	0	0	0	170.0
8	84	1	1	1	0	1	0	0	0	117.0
8	84	0	0	0	0	1	0	0	0	148.0
8	84	0	1	0	0	1	0	0	0	115.0
8	84	0	1	1	0	1	0	0	0	94.0
7	72	0	0	0	0	1	0	0	0	74.0
7	72	0	0	1	0	1	0	0	0	52.0
7	72	0	1	1	0	1	0	0	0	21.0

5	62	0	0	0	0	1	0	0	0	10.0
9	85	1	1	0	0	1	0	0	0	185.0
9	85	0	0	0	0	1	0	0	0	194.0
9	85	0	1	0	0	1	0	0	0	163.0
9	85	0	1	1	0	1	0	0	0	142.0
7	60	0	0	0	0	1	0	0	0	49.0
7	60	0	1	0	0	1	0	0	0	17.0
7	60	0	1	1	0	1	0	0	0	11.0
4	72	0	0	0	0	1	0	0	0	15.0
5	56	0	0	0	0	1	0	0	0	12.0
8	92	0	0	0	0	1	0	0	0	188.0
8	92	1	0	0	0	1	0	0	0	166.0
8	92	1	1	0	0	1	0	0	0	133.0
8	92	1	0	1	0	1	0	0	0	143.0
8	92	0	1	1	0	1	0	0	0	111.0
8	93	0	0	0	0	1	0	0	0	167.0
8	93	0	1	0	0	1	0	0	0	135.0
8	93	0	1	1	0	1	0	0	0	112.0
8	87	1	0	0	0	1	0	0	0	177.0
8	87	0	0	0	0	1	0	0	0	154.0
8	87	0	1	0	0	1	0	0	0	122.0
8	87	0	1	1	0	1	0	0	0	99.0
7	87	0	0	0	0	1	0	0	0	107.0
7	87	0	1	0	0	1	0	0	0	75.0
7	87	0	1	1	0	1	0	0	0	53.0
5	83	0	0	0	0	1	0	0	0	30.0
7	91	0	0	0	0	1	0	0	0	117.0
9	100	1	0	0	0	1	0	0	0	253.0
9	100	1	0	1	0	1	0	0	0	232.0
9	100	0	0	0	0	1	0	0	0	230.0
9	100	0	1	0	0	1	0	0	0	197.0
9	100	0	1	1	0	1	0	0	0	174.0
8	93	0	0	0	0	1	0	0	0	167.0
8	93	0	0	1	0	1	0	0	0	145.0
5	84	0	0	0	0	1	0	0	0	7.0
8	87	0	0	0	0	1	0	0	0	154.0
8	100	0	0	0	0	1	0	0	0	183.0
7	87	0	0	0	0	1	0	0	0	107.0
8	94	0	0	0	0	1	0	0	0	170.0
9	90	0	0	0	0	1	0	0	0	208.0
9	92	0	0	0	0	1	0	0	0	212.0
4	86	0	0	0	0	1	0	0	0	12.0
6	89	0	0	0	0	1	0	0	0	65.0
7	88	0	0	0	0	1	0	0	0	110.0
8	90	0	0	0	0	1	0	0	0	161.0
10	100	1	0	0	0	0	1	0	0	547.0
10	100	1	1	0	0	0	1	0	0	527.0
10	100	1	1	1	0	0	1	0	0	503.0
10	100	0	0	0	0	0	1	0	0	545.0
10	100	0	1	0	0	0	1	0	0	525.0
10	100	0	1	1	0	0	1	0	0	500.0
7	94	1	0	0	0	0	1	0	0	237.0
7	94	0	1	0	0	0	1	0	0	214.0
8	90	1	0	0	0	0	1	0	0	251.0
8	90	1	1	0	0	0	1	0	0	231.0
8	90	0	0	0	0	0	1	0	0	249.0
8	90	0	1	0	0	0	1	0	0	228.0
8	90	0	1	1	0	0	1	0	0	204.0
8	96	1	0	0	0	0	1	0	0	340.0
8	96	0	0	0	0	0	1	0	0	338.0
8	96	0	1	0	0	0	1	0	0	318.0
8	96	0	1	1	0	0	1	0	0	293.0
7	88	1	0	0	0	0	1	0	0	147.0
7	88	0	0	0	0	0	1	0	0	145.0
7	88	0	1	0	0	0	1	0	0	125.0
7	88	0	1	1	0	0	1	0	0	101.0
5	74	0	0	0	0	0	1	0	0	11.0
5	74	0	1	0	0	0	1	0	0	13.0
9	98	1	0	0	0	0	1	0	0	444.0

9	98	1	1	0	0	0	1	0	0	423.0
9	98	0	0	0	0	0	1	0	0	442.0
9	98	0	1	0	0	0	1	0	0	421.0
9	98	0	1	1	0	0	1	0	0	397.0
7	93	0	0	0	0	0	1	0	0	220.0
7	93	0	1	0	0	0	1	0	0	200.0
7	93	0	1	1	0	0	1	0	0	175.0
4	75	0	0	0	0	0	1	0	0	12.0
4	78	0	0	0	0	0	1	0	0	11.0
4	78	0	1	0	0	0	1	0	0	11.0
8	93	0	0	0	0	0	1	0	0	293.0
8	93	0	1	0	0	0	1	0	0	273.0
8	93	1	0	1	0	0	1	0	0	269.0
8	83	0	0	0	0	0	1	0	0	147.0
8	83	0	0	0	0	0	1	0	0	145.0
8	83	0	1	0	0	0	1	0	0	124.0
8	83	0	1	1	0	0	1	0	0	100.0
8	94	0	0	0	0	0	1	0	0	308.0
8	94	0	1	0	0	0	1	0	0	288.0
8	94	0	1	0	0	0	1	0	0	266.0
7	88	0	0	0	0	0	1	0	0	145.0
7	88	0	1	0	0	0	1	0	0	125.0
7	88	0	0	1	0	0	1	0	0	121.0
5	83	0	0	0	0	0	1	0	0	14.0
7	88	0	0	0	0	0	1	0	0	145.0
7	88	0	1	1	0	0	1	0	0	101.0
9	100	1	0	0	0	0	1	0	0	474.0
9	100	0	0	0	0	0	1	0	0	471.0
9	100	0	1	0	0	0	1	0	0	451.0
8	87	0	0	0	0	0	1	0	0	204.0
8	87	0	1	0	0	0	1	0	0	184.0
5	84	0	0	0	0	0	1	0	0	23.0
8	87	0	0	0	0	0	1	0	0	204.0
8	90	0	0	0	0	0	1	0	0	249.0
8	90	0	1	0	0	0	1	0	0	228.0
7	86	0	0	0	0	0	1	0	0	115.0
8	89	0	0	0	0	0	1	0	0	123.0
9	89	0	0	0	0	0	1	0	0	308.0
9	98	0	0	0	0	0	0	1	0	442.0
4	89	0	0	0	0	0	0	1	0	33.0
6	88	0	0	0	0	0	0	1	0	71.0
7	90	0	0	0	0	0	0	1	0	145.0
8	94	0	0	0	0	0	0	1	0	308.0
10	93	1	0	0	0	0	0	1	0	420
10	93	0	0	0	0	0	0	1	0	381
10	93	0	1	1	0	0	0	1	0	340
7	85	0	1	1	0	0	0	1	0	162
8	78	0	0	0	0	0	0	1	0	184
8	83	0	1	1	0	0	0	1	0	142
9	76	1	0	0	0	0	0	1	0	252
9	76	0	0	0	0	0	0	1	0	251
9	76	0	1	0	0	0	0	1	0	210
9	76	0	1	1	0	0	0	1	0	165
7	70	0	0	0	0	0	0	1	0	85
8	74	0	0	0	0	0	0	1	0	150
8	74	0	1	1	0	0	0	1	0	112
8	70	0	0	0	0	0	0	1	0	120
8	70	0	1	0	0	0	0	1	0	132
8	70	0	1	1	0	0	0	1	0	88
5	78	0	1	0	0	0	0	1	0	66
8	92	0	0	0	0	0	0	1	0	298
8	92	0	1	0	0	0	0	1	0	265
8	92	0	1	1	0	0	0	1	0	210
7	93	0	0	0	0	0	0	1	0	262
7	93	0	1	0	0	0	0	1	0	269
5	88	0	0	0	0	0	0	1	0	168
5	88	0	0	1	0	0	0	1	0	110
7	91	0	0	0	0	0	0	1	0	264
7	91	0	1	0	0	0	0	1	0	232
9	98	1	0	0	0	0	0	1	0	420
9	98	0	0	0	0	0	0	1	0	420
9	98	0	1	0	0	0	0	1	0	360

9	98	0	1	1	0	0	0	1	0	287
8	96	0	0	0	0	0	0	1	0	328
8	96	0	1	0	0	0	0	1	0	311
8	96	0	1	1	0	0	0	1	0	265
5	87	0	0	0	0	0	0	1	0	141
8	94	0	0	0	0	0	0	1	0	330
8	94	0	0	1	0	0	0	1	0	230
8	96	0	0	0	0	0	0	1	0	320
8	96	0	1	0	0	0	0	1	0	311
7	86	0	0	0	0	0	0	1	0	212
8	88	0	0	0	0	0	0	1	0	265
9	89	0	0	0	0	0	0	1	0	329
9	100	0	0	0	0	0	0	1	0	400
4	88	0	0	0	0	0	0	1	0	108
6	89	0	0	0	0	0	0	1	0	195
7	89	0	0	0	0	0	0	1	0	230
8	92	0	0	0	0	0	0	1	0	294
10	98	0	0	1	0	0	0	0	1	572
10	98	0	1	1	0	0	0	0	1	855
10	98	0	1	0	0	0	0	0	1	576
10	98	1	0	1	0	0	0	0	1	860
10	98	1	1	0	0	0	0	0	1	564
7	92	0	0	1	0	0	0	0	1	690
7	92	0	1	1	0	0	0	0	1	673
7	92	0	0	0	0	0	0	0	1	710
7	92	1	0	1	0	0	0	0	1	678
8	55	0	0	1	0	0	0	0	1	322
8	55	0	1	1	0	0	0	0	1	305
8	55	1	1	0	0	0	0	0	1	313
8	90	0	0	1	0	0	0	0	1	704
8	90	0	0	1	0	0	0	0	1	704
8	90	0	1	1	0	0	0	0	1	390
7	70	1	0	1	0	0	0	0	1	436
7	70	1	0	1	0	0	0	0	1	436
7	70	1	1	1	0	0	0	0	1	419
9	93	0	0	1	0	0	0	0	1	779
9	93	0	1	1	0	0	0	0	1	762
9	93	1	0	1	0	0	0	0	1	767
9	93	0	1	1	0	0	0	0	1	762
9	93	1	1	0	0	0	0	0	1	770
7	88	0	0	1	0	0	0	0	1	646
7	88	1	0	1	0	0	0	0	1	634
7	88	1	1	1	0	0	0	0	1	617
4	65	0	0	1	0	0	0	0	1	277
4	65	0	1	1	0	0	0	0	1	260
4	65	1	0	1	0	0	0	0	1	265
4	65	1	1	1	0	0	0	0	1	248
5	69	0	0	0	0	0	0	0	1	380
5	69	0	0	0	0	0	0	0	1	380
5	69	1	1	1	0	0	0	0	1	331
8	90	0	0	1	0	0	0	0	1	707
8	90	1	0	1	0	0	0	0	1	695
8	90	1	1	1	0	0	0	0	1	678
8	90	1	1	0	0	0	0	0	1	698
8	85	1	0	1	0	0	0	0	1	640
8	85	1	1	1	0	0	0	0	1	623
8	85	1	1	0	0	0	0	0	1	643
5	66	0	0	1	0	0	0	0	1	327
5	66	1	0	1	0	0	0	0	1	315
5	66	1	1	1	0	0	0	0	1	298
8	85	0	0	1	0	0	0	0	1	652
8	85	1	0	1	0	0	0	0	1	640
8	85	1	1	1	0	0	0	0	1	623
8	85	1	1	0	0	0	0	0	1	643
7	76	0	0	1	0	0	0	0	1	514
7	76	1	0	1	0	0	0	0	1	502
7	76	1	1	1	0	0	0	0	1	485
7	76	1	1	0	0	0	0	0	1	505
5	74	0	0	1	0	0	0	0	1	415
5	74	1	0	1	0	0	0	0	1	403
5	74	1	1	1	0	0	0	0	1	386
7	79	0	0	1	0	0	0	0	1	547

7	79	1	0	1	0	0	0	0	1	535
7	79	1	1	1	0	0	0	0	1	518
9	100	0	0	1	0	0	0	0	1	956
9	100	0	1	1	0	0	0	0	1	839
9	100	1	0	1	0	0	0	0	1	944
9	100	1	1	1	0	0	0	0	1	827
9	100	1	0	0	0	0	0	0	1	864
9	100	1	1	0	0	0	0	0	1	847
8	90	0	0	1	0	0	0	0	1	707
8	90	1	0	1	0	0	0	0	1	695
8	90	1	1	0	0	0	0	0	1	698
5	80	1	0	1	0	0	0	0	1	469
8	90	0	0	1	0	0	0	0	1	707
8	90	1	0	1	0	0	0	0	1	695
8	90	1	1	1	0	0	0	0	1	678
8	100	0	0	1	0	0	0	0	1	817
8	100	0	1	0	0	0	0	0	1	820
8	100	1	0	1	0	0	0	0	1	805
8	100	1	1	1	0	0	0	0	1	788
8	100	1	0	0	0	0	0	0	1	825
7	88	1	0	1	0	0	0	0	1	637
8	89	1	0	1	0	0	0	0	1	684
9	90	1	0	1	0	0	0	0	1	734
9	87	0	0	1	0	0	0	0	1	713
4	86	1	0	1	0	0	0	0	1	496
6	88	1	0	1	0	0	0	0	1	596
7	90	1	0	1	0	0	0	0	1	656
8	91	1	0	1	0	0	0	0	1	706

HAUT BRION (Non-linear)

Vintage	Parker's score	Vintage* Parker's score	Vintage^2	Parker's score^2	Offer	Ullage	Label condition	Unit price (in US$)
10	100	1000	100	10000	1	0	1	373
10	100	1000	100	10000	1	1	1	350
10	100	1000	100	10000	1	0	0	377
10	100	1000	100	10000	0	0	1	360
10	100	1000	100	10000	0	1	1	356
10	100	1000	100	10000	0	1	0	370
7	88	616	49	7744	0	0	1	40
7	88	616	49	7744	0	1	0	50
8	90	720	64	8100	0	0	1	140
8	90	720	64	8100	0	1	1	132
8	86	688	64	7396	1	0	1	90
8	86	688	64	7396	0	0	1	75
8	86	688	64	7396	0	1	0	86
9	85	765	81	7225	0	0	1	138
9	85	765	81	7225	0	1	1	111
9	85	765	81	7225	0	1	0	131
7	88	616	49	7744	0	0	1	60
7	88	616	49	7744	0	1	1	34
7	88	616	49	7744	0	1	0	50
5	76	380	25	5776	0	0	1	10
8	93	744	64	8649	1	0	1	169
8	93	744	64	8649	0	0	1	175
8	93	744	64	8649	0	1	1	145
8	93	744	64	8649	0	1	0	166
8	86	688	64	7396	0	0	1	93
8	86	688	64	7396	0	1	1	66
8	86	688	64	7396	0	0	0	92
8	90	720	64	8100	0	0	1	140
8	90	720	64	8100	0	0	1	139
7	93	651	49	8649	0	0	1	99
7	93	651	49	8649	0	1	0	109
7	85	595	49	7225	0	0	1	23
9	94	846	81	8836	1	0	1	235
9	94	846	81	8836	0	0	1	230
9	94	846	81	8836	0	0	0	246
8	87	696	64	7569	0	0	1	85
8	87	696	64	7569	0	0	0	105
5	84	420	25	7056	0	0	1	20
8	94	752	64	8836	0	0	1	168
8	94	752	64	8836	0	0	0	185
8	96	768	64	9216	0	0	1	191
8	96	768	64	9216	0	0	0	210
7	88	616	49	7744	0	0	1	57
8	91	728	64	8281	0	0	1	152
9	100	900	81	10000	0	0	1	325
9	96	864	81	9216	0	0	1	270
6	90	540	36	8100	0	0	1	25
8	93	744	64	8649	0	0	1	175

LATOUR (Non-linear)

Vintage	Parker's score	Vintage* Parker's score	Vintage^2	Parker's score^2	Offer	Ullage	Label condition	Unit price (in US$)
10	100	1000	100	10000	1	0	0	547.0
10	100	1000	100	10000	1	1	0	527.0
10	100	1000	100	10000	1	1	1	503.0
10	100	1000	100	10000	0	0	0	545.0
10	100	1000	100	10000	0	1	0	525.0
10	100	1000	100	10000	0	1	1	500.0
7	94	658	49	8836	1	0	0	237.0
7	94	658	49	8836	0	1	0	214.0
8	90	720	64	8100	1	0	0	251.0
8	90	720	64	8100	1	1	0	231.0
8	90	720	64	8100	0	0	0	249.0
8	90	720	64	8100	0	1	0	228.0
8	90	720	64	8100	0	1	1	204.0
8	96	768	64	9216	1	0	0	340.0
8	96	768	64	9216	0	0	0	338.0
8	96	768	64	9216	0	1	0	318.0
8	96	768	64	9216	0	1	1	293.0
7	88	616	49	7744	1	0	0	147.0
7	88	616	49	7744	0	0	0	145.0
7	88	616	49	7744	0	1	0	125.0
7	88	616	49	7744	0	1	1	101.0
5	74	370	25	5476	0	0	0	11.0
5	74	370	25	5476	0	1	0	13.0
9	98	882	81	9604	1	0	0	444.0
9	98	882	81	9604	1	1	0	423.0
9	98	882	81	9604	0	0	0	442.0
9	98	882	81	9604	0	1	0	421.0
9	98	882	81	9604	0	1	1	397.0
7	93	651	49	8649	0	0	0	220.0
7	93	651	49	8649	0	1	0	200.0
7	93	651	49	8649	0	1	1	175.0
4	75	300	16	5625	0	0	0	12.0
4	78	312	16	6084	0	0	0	11.0
4	78	312	16	6084	0	1	0	11.0
8	93	744	64	8649	0	0	0	293.0
8	93	744	64	8649	0	1	0	273.0
8	93	744	64	8649	1	0	1	269.0
8	83	664	64	6889	0	0	0	147.0
8	83	664	64	6889	0	0	0	145.0
8	83	664	64	6889	0	1	0	124.0
8	83	664	64	6889	0	1	1	100.0
8	94	752	64	8836	0	0	0	308.0
8	94	752	64	8836	0	1	0	288.0
8	94	752	64	8836	0	1	0	288.0
7	88	616	49	7744	0	0	0	145.0
7	88	616	49	7744	0	1	0	125.0
7	88	616	49	7744	0	0	1	121.0
5	83	415	25	6889	0	0	0	14.0
7	88	616	49	7744	0	0	0	145.0
7	88	616	49	7744	0	1	1	101.0
9	100	900	81	10000	1	0	0	474.0
9	100	900	81	10000	0	0	0	471.0
9	100	900	81	10000	0	1	0	451.0
8	87	696	64	7569	0	0	0	204.0
8	87	696	64	7569	0	1	0	184.0
5	84	420	25	7056	0	0	0	23.0
8	87	696	64	7569	0	0	0	204.0
8	90	720	64	8100	0	0	0	249.0
8	90	720	64	8100	0	1	0	228.0
7	86	602	49	7396	0	0	0	115.0
8	89	712	64	7921	0	0	0	123.0
9	89	801	81	7921	0	0	0	308.0
9	98	882	81	9604	0	0	0	442.0
4	89	356	16	7921	0	0	0	33.0
6	88	528	36	7744	0	0	0	71.0
7	90	630	49	8100	0	0	0	145.0
8	94	752	64	8836	0	0	0	308.0

MARGAUX (Non-linear)

Vintage	Parker's score	Vintage* Parker's score	Vintage^2	Parker's score^2	Offer	Ullage	Label condition	Unit price (in US$)
10	93	930	100	8649	1	0	0	420
10	93	930	100	8649	0	0	0	381
10	93	930	100	8649	0	1	1	340
7	85	595	49	7225	0	1	1	162
8	78	624	64	6084	0	0	0	184
8	83	664	64	6889	0	1	1	142
9	76	684	81	5776	1	0	0	252
9	76	684	81	5776	0	0	0	251
9	76	684	81	5776	0	1	0	210
9	76	684	81	5776	0	1	1	165
7	70	490	49	4900	0	0	0	85
8	74	592	64	5476	0	0	0	150
8	74	592	64	5476	0	1	1	112
8	70	560	64	4900	0	0	0	120
8	70	560	64	4900	0	1	0	132
8	70	560	64	4900	0	1	1	88
5	78	390	25	6084	0	1	0	88
8	92	736	64	8464	0	0	0	298
8	92	736	64	8464	0	1	0	285
8	92	736	64	8464	0	1	1	210
7	93	651	49	8649	0	0	0	262
7	93	651	49	8649	0	1	0	269
5	88	440	25	7744	0	0	0	168
5	88	440	25	7744	0	0	1	110
7	91	637	49	8281	0	0	0	254
7	91	637	49	8281	0	1	0	232
9	98	882	81	9604	1	0	0	420
9	98	882	81	9604	0	0	0	420
9	98	882	81	9604	0	1	0	360
9	98	882	81	9604	0	1	1	287
8	96	768	64	9216	0	0	0	328
8	96	768	64	9216	0	1	0	311
8	96	768	64	9216	0	1	1	265
5	87	435	25	7569	0	0	0	141
8	94	752	64	8836	0	0	0	330
8	94	752	64	8836	0	0	1	230
8	96	768	64	9216	0	0	0	320
8	96	768	64	9216	0	1	0	311
7	86	602	49	7396	0	0	0	212
8	88	704	64	7744	0	0	0	265
9	89	801	81	7921	0	0	0	320
9	100	900	81	10000	0	0	0	400
4	88	352	16	7744	0	0	0	108
6	89	534	36	7921	0	0	0	195
7	89	623	49	7921	0	0	0	230
8	92	736	64	8464	0	0	0	294

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